Draft Report

DIESEL PARTICULATE MATTER MITIGATION PLAN FOR THE BNSF RAILROAD COMMERCE-MECHANICAL RAIL YARD

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I. Introduction

In accordance with the 2005 California Air Resources Board (CARB)/Railroad Statewide Agreement (MOU), BNSF has prepared this Mitigation Plan for the Commerce-Mechanical Rail Yard. The purpose of this Plan is to outline the potential mitigation measures that can be used reduce Diesel particulate matter (DPM) emissions from the Commerce-Mechanical Rail Yard. The Plan also contains sections detailing how the baseline and forecasted emissions were calculated and mechanisms that will be used to track progress.

As discussed below, the proposed Mitigation Measures, when fully implemented, will reduce the DPM emissions from the Commerce-Mechanical Yard by 63% from 2005 baseline with forecasted activity growth. These emission reductions will concurrently lower any existing predicted health risk associated with the facility operations. Other federal, state, and other related air pollution control measures and plans, and existing railroad voluntary agreement measures will supplement the current and future emission reduction discussed in this Plan. The baseline emissions were described in great detail in a series of reports that are publicly available (http://www.arb.ca.gov/railyard/hra/hra.htm).

II. Summary of Rail Yard Operations

The operations at the Commerce-Mechanical facility include engine-on locomotive activity within the service facility, switching engine activity to position individual cars for repair, and the adjacent mainline tracks. The service activity includes basic inspection (refueling, refill the traction sand, and other activities) as well as more extensive inspection and maintenance of locomotives that include full load and opacity testing.

III. Emissions Summary

Table 3-1 below, shows the DPM emissions from the Commerce-Mechanical Yard, by equipment category, for the 2005 baseline year and for future years as the mitigation measures proposed in this Plan are implemented over time. As shown in Table 3-1, when the proposed mitigation measures are implemented DPM emissions will be reduced by approximately 68% percent without considering activity growth. These emission reductions will concurrently lower any existing predicted health risk related to facility operations. A detailed discussion of each mitigation measure is provided in Section VI.

The projected emission reduction calculations shown in Table 1 assume a gradual increase in fuel dispensed at the Commerce-Mechanical Yard over time. The assumptions and methodologies used to predict the rate of growth are discussed in Section V. In addition, the analysis takes into account certain other future regulatory measures and voluntary agreements, which will be implemented and effective by 2020 (e.g., CARB's Cargo Handling Equipment regulations, federal truck emission rules, 1998 and 2005 CARB MOUs).

In summary the emission totals for all rail yards were compiled using the adjustments to the emission inventory projecting fleet turnover and future year emission rates. The totals, by source category, are provided in Table 3-1 for Commerce-Mechanical.

Table 3-1. Estimated total annual DPM emissions (metric tonnes) associated with the operations at the Commerce- Mechanical facility with 2005 activity levels.

Commerce – Mechanical	2005	2005 Update	2010	2015	2020
Basic Services	1.27	1.55[1]	0.868	0.62	0.382
Basic Engine Inspection	0.25	0.25	0.224	0.162	0.097
Full Engine Service/Inspection	0.33	0.33	0.295	0.214	0.128
Switching running	0.03	0.03	0.032	0.020	0.018
Switching idling	0.02	0.02	0.011	0.007	0.006
Arriving and Departing Trains	0	0	0	0	0
Adjacent Freight Movements	0.105	0.105	0.10	0.078	0.047
Adjacent Commuter Rail Operations	0.03	0.03	0.03	0.03	0.03
Cargo Handling Equipment	0	0	0	0	0
On-Road Container Truck Operations	0	0	0	0	0
On-Road Container Truck Operations, Contractors	0	0	0	0	0
On-Road Fleet Vehicle	0	0	0	0	0
Other Off-Road TRU	0	0	0	0	0
Other Off-Road Track Maintenance	0.01	0.01	0.01	0.01	0.01
Other Off-Road Portable Engines	0.37	0.37	0.31	0.23	0.15
Stationary Sources	0	0	0	0	0
Total (without growth)	**2.42**	**2.70**	**1.88**	**1.37**	**0.87**
Reduction % (without growth)			**30%**	**49%**	**68%**
Total (with growth included)			**1.96**	**1.50**	**1.00**
Reduction % (with growth)			**27%**	**44%**	**63%**

1 – Revision of the number of locomotives refueled

IV. Emission Inventory Methodology

In forecasting emissions at rail yards, ENVIRON projected the impact of several rulemakings and voluntary initiatives. These rulemakings and initiatives include emission reductions expected to result from Federal, State, and voluntary emission reduction strategies from all sources. The emission reductions will primarily result from normal and accelerated fleet turnover to engines meeting more stringent new engine emission standards. Normal fleet turnover is the fleet replacement expected due to retirement of older equipment for mechanical or other business reasons. Accelerated turnover of equipment is the centerpiece of many California rulemakings and some voluntary initiatives and is expected to result in emission reductions in years immediately after a change in the new engine emission standards. Retrofit of older equipment is often available as an alternative element to comply with accelerated turnover.

The emission sources affected include the following source categories:

- Locomotives (Line-Haul Maintenance & Switching)
- HHD Diesel-Fueled Drayage Trucks

- Cargo Handling Equipment
- Heavy Equipment
- Transport Refrigeration Units (TRU) and Refrigerated Railcars
- Other Miscellaneous Diesel-Fueled Equipment

The emissions consider a constant 2005 level of activity and apply activity changes after the fact. Overall ENVIRON expects emissions from rail yards to have significant reductions in the years 2005 through 2020 as a result of Federal, State, and local initiatives affecting new engines and of replacement or retrofit of older equipment with engines and equipment using low emission technology. The projected emission reductions without considering growth range from 30% to 68% at the same activity level in 2005, and adding the expected growth results in emission reductions from 27% to 63%. A no growth scenario was run to determine the emission reduction due to fleet turnover or other measures prior to applying any growth estimate. The growth estimates for this yard consist of two primary activity indicators, fuel dispensed on site and mainline traffic passing the yard. The mainline traffic is unrelated to the yard but was another emission source within the boundaries of the site studied. The no growth and growth scenarios are shown in Table 4-1 and in Figure 4-1 for Commerce – Mechanical rail yard.

Table 4-1. DPM emission (metric tonnes per year) projection summary for BNSF Commerce-Mechanical.

Yard (condition)	2005	2010	2015	2020
No growth	2.70	1.88	1.37	0.87
With growth	---	1.96	1.50	1.00

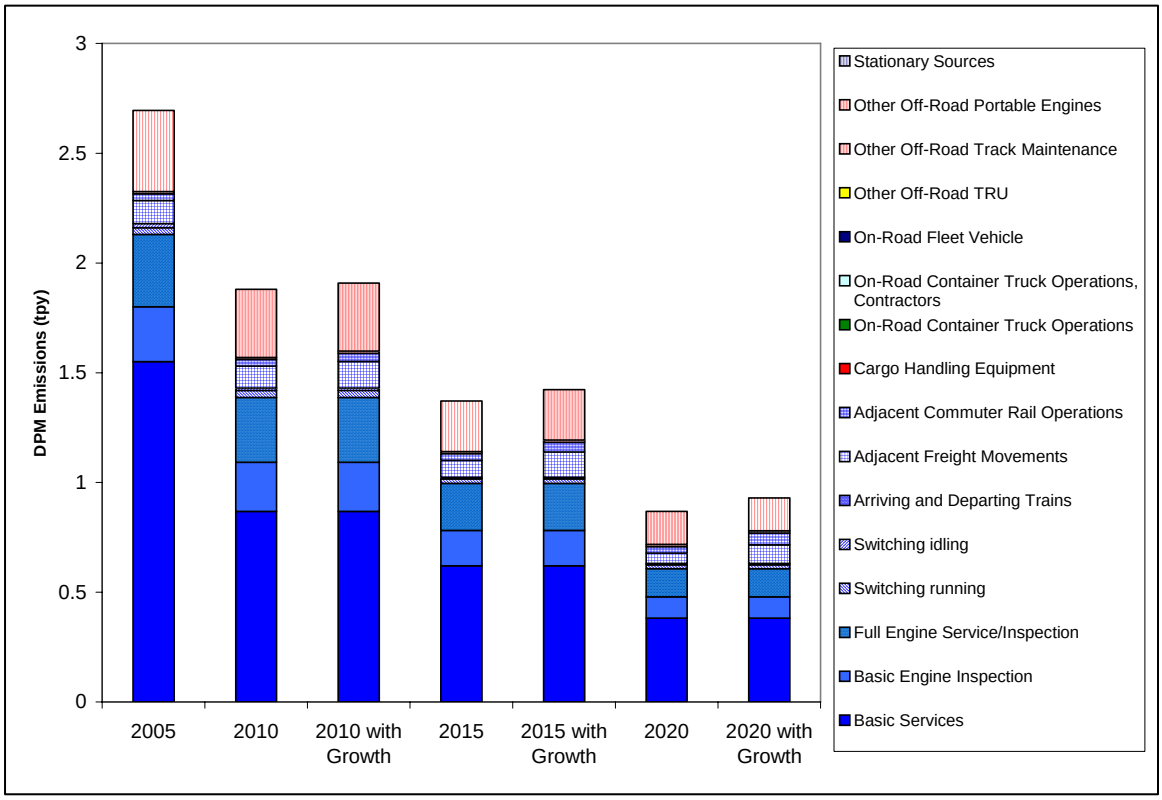

Figure 4-1: BNSF Commerce-Mechanical emission summary (With and without growth).

A general discussion of the analytical methodology and assumptions used to calculate the 2005 baseline emissions and to forecast emissions for calendar years 2010 through 2020, for each equipment category is provided below. Detailed emission calculations for the 2005 baseline year can be found in the Commerce-Mechanical Facility Toxic Air Contaminants Emissions Inventory with modifications for the revised emission inventory methods described in this report.

1. Locomotives

BNSF has agreed ("Memorandum of Mutual Understandings and Agreements," July 2, 1998) to meet Tier 2 fleet average emissions for all locomotives operating in the South Coast. This agreement will be met in one of variety of possible ways through averaging very low emitters with engines not meeting Tier 2 levels.

In addition, BNSF has agreed in the MOU (ARB/Railroad Statewide Agreement, "Particulate Emission Reduction Program at California Rail Yards," June 2005) to reduce idling and to use lower sulfur fuels for locomotives based and refueled in California.

The reduced idling agreement calls for engines based in California to be refit with idle shut-off devices, limiting each idle event to no more than 15 minutes. This will affect all switching engines at California yards and likely most line-haul engines operating in the South Coast where many line-haul engines may be dedicated to that area. ENVIRON assumed that all BNSF new engines are fitted with idle shutoff; so at least all Tier 2 engines were expected to use these devices.

BNSF agreed to accelerate the use of low sulfur fuel in California ahead of the Federal standard for 15 ppm sulfur starting in 2012. By agreement, BNSF will use 15 ppm sulfur in 80% of the California refueling gallons with the remaining assumed to be at the 2007 Federal standard of 500 ppm. Based on an assessment of the in-bound engines using Federal fuel and out-bound engines using California fuel along with refueling rates at locations inside and outside of California, ENVIRON calculated the average sulfur level to be no higher than 0.034% in 2007-2011 time frame compared with 0.105% in 2005 due to the agreement.

EPA announced final emission standards (EPA, 2008) that include an analysis of the expected benefit of normal fleet turnover and the additional benefit of the EPA rule. The emission standards include a retrofit of existing equipment as well as new engine emission standards. Existing Tier 0, 1, and 2 engines will be subject to retrofit at the time of rebuild; so the engines will be rebuilt gradually throughout their remaining useful life.

The emissions standards and projected EPA emission factors are shown in Tables 4-2 and 4-3, depending on the duty cycle chosen to certify the engines - either line-haul or switching engine duty cycles. The duty cycle for line-haul engines typically leads to lower emission on a gram per horsepower-hour (hp-hr) basis because the switching engine duty cycle has a considerable idling time (no hp-hr generated). In some cases the uncontrolled emissions are much lower than some of the emission standards, so no emission reduction would be expected from those standards especially for HC and CO emissions. The relative emission factors provided by EPA were used to adjust the locomotive emission rates. For instance, for the Tier 2 remanufactured engines the PM emissions were reduced by 55.6% that reflect the expected emission reduction from 0.08 g/hp-hr for remanufactured locomotives compared to 0.18 g/hp-hr for the baseline Tier 2 locomotives in Table 4-2b.

Table 4-2a. Locomotive – Emission standards (g/hp-hr) for line-haul (duty cycle) engines.

Emission Standard	Applicable Year	HC (g/hp-hr)	CO (g/hp-hr)	NOx (g/hp-hr)	PM (g/hp-hr)
Uncontrolled Emissions	**Pre-1973**	**0.48**	**1.28**	**13.0**	**0.32**
Tier 0 – original	1973 – 2001	1.00	5.0	9.5	0.60
Tier 0 – final[1]	2008 / 2010	1.00	5.0	8.0	0.22
Tier 1 – original	2002 – 2004	0.55	2.2	7.4	0.45
Tier 1 – final[1]	2008 / 2010	0.55	5.0	7.4	0.22
Tier 2 – original	2005	0.30	1.5	5.5	0.20
Tier 2 – final[1]	2013	0.30	1.5	5.5	0.10
Tier 3	2012 – 2014	0.30	1.5	5.5	0.10
Tier 4 [2]	2015	0.14	1.5	1.3	0.03

[1] These are retrofit standards at the time of rebuild and phased in as retrofit kit availability.
[2] The Tier 4 NOx standard can be a 1.4 NOx + HC standard.

Table 4-2b. Locomotive – EPA projected emissions factors (g/hp-hr) for line-haul engines.

Engine Type	Applicable Year	HC (g/hp-hr)	CO (g/hp-hr)	NOx (g/hp-hr)	PM (g/hp-hr)
Uncontrolled Emissions	**Pre-1973**	**0.48**	**1.28**	**13.0**	**0.32**
Tier 0 – original	1973 – 2001	0.48	1.28	8.60	0.32
Tier 0 – final[1]	2008 / 2010	0.30	1.28	7.20	0.20
Tier 1 – original	2002 – 2004	0.47	1.28	6.70	0.32
Tier 1 – final[1]	2008 / 2010	0.29	1.28	6.70	0.20
Tier 2 – original	2005	0.26	1.28	5.50	0.18
Tier 2 – final[1]	2008 / 2013	0.13	1.28	4.95	0.08
Tier 3	2012 – 2014	0.13	1.28	4.95	0.08
Tier 4 [2]	2015	0.04	1.28	1.00	0.015

[1] These are estimated emissions with retrofit with some exceptions for older Tier 0 engines.
[2] The Tier 4 NOx standard would not apply until 2017, while the other standards would apply starting in 2015. The Tier 4 NOx standard would apply, however, at remanufacture for model year 2015 and 2016 locomotives.

Table 4-3a. Locomotive – Emission standards for switching (duty cycle) engines.

Emission Standard	Applicable Year	HC (g/hp-hr)	CO (g/hp-hr)	NOx (g/hp-hr)	PM (g/hp-hr)
Uncontrolled Emissions	**Pre-1973**	**1.01**	**1.83**	**17.4**	**0.44**
Tier 0 – original	1973 – 2001	2.10	8.0	14.00	0.72
Tier 0 – final[1]	2008 / 2010	2.10	8.0	11.80	0.26
Tier 1 – original	2002 – 2004	1.20	2.5	11.00	0.54
Tier 1 – final[1]	2008 / 2010	1.20	2.5	11.00	0.26
Tier 2 – original	2005	0.60	2.4	8.10	0.24
Tier 2 – final[1]	2008 / 2013	0.60	2.4	8.10	0.13
Tier 3	2011 - 2015	0.60	2.4	5.00	0.10
Tier 4 [2]	2015	0.14	2.4	1.30	0.03

1 These are retrofit standards at the time of rebuild and phased in as retrofit kit availability allows.
2 The Tier 4 NOx standard can be a 1.3 NOx + HC standard.

Table 4-3b. Locomotive – EPA projected emission factors for switching (duty cycle) engines.

Engine Type	Applicable Year	HC (g/hp-hr)	CO (g/hp-hr)	NOx (g/hp-hr)	PM (g/hp-hr)
Uncontrolled Emissions	**Pre-1973**	**1.01**	**1.83**	**17.4**	**0.44**
Tier 0 – original	1973 – 2001	1.01	1.83	14.0	0.44
Tier 0 – final[1]	2008 / 2010	0.57	1.83	10.62	0.23
Tier 1 – original	2002 – 2004	1.01	1.83	9.9	0.43
Tier 1 – final[1]	2008 / 2010	0.57	1.83	9.9	0.23
Tier 2 – original	2005	0.51	1.83	7.3	0.19
Tier 2 – final[1]	2008 / 2013	0.26	1.83	7.3	0.11
Tier 3	2011 - 2015	0.26	1.83	5.4	0.08
Tier 4 [2]	2015	0.08	1.83	1.00	0.015

1 These are estimated emissions with retrofit with some exceptions for older Tier 0 engines.
2 The Tier 4 NOx standard would not apply until 2017, while the other standards would apply starting in 2015. The Tier 4 NOx standard would apply, however, at remanufacture for model year 2015 and 2016 locomotives.

a) Line-haul Locomotives

Line-haul locomotives are primary workhorses for the railroads and are also those that need to the most maintenance. They are also the primary locomotives used along the adjacent mainline.

Because the South Coast agreement is an averaging standard, the exact fleet composition may change from day to day. For the purposes of this work, ENVIRON assumed a fleet mix of locomotives such that 75% of the fleet were GE ES44DC engines that meet NOx and other pollutant emission levels below the Tier 2 standard, and 15% were GE Dash 9 engines meeting the Tier 1 standard. The remaining 10% of line-haul locomotives were Tier 0 GE Dash 9. This assumption of the fleet make-up somewhat overstates future year emissions because Dash 9 and the Tier 2 engines have higher rated power than some of the engines used in 2005. Therefore either fewer engines or lower power notch settings would be used to perform the same work.

For 2015 and 2020, ENVIRON estimated the fleet turnover to Tier 3 and Tier 4 engines to be 3% per year with the equivalent fleet replacement of Tier 0, Tier 1, and Tier 2 engines by the Tier 3 and Tier 4 engines. ENVIRON assumed that the Tier 3 and 4 engines percentage emissions reductions would occur equivalently for all modes (idle and notches) from the Tier 2 engines. The Tier 3 PM emission standard is essentially the same as the rebuilt Tier 2, but the engines meeting Tier 4 standards have a lower PM emission standard.

BNSF estimated that the remaining Tier 0 and Tier 1 engines would undergo engine rebuilds every 6 years or 17% of the fleet per year. Likewise because Tier 2 engines would be rebuilt every 8 years, 12.5% of the Tier 2 fleet would be rebuilt per year. The final rebuild kits would be available for all engines starting in 2010 for Tier 0 and Tier 1, and 2013 for Tier 2. Some emission reductions could occur earlier, but ENVIRON chose to ignore the phase-in period for rebuild kits. The emission reduction was calculated to be 37.5% for Tier 0 and 1 rebuilds (0.20 g/hp-hr compared to the baseline PM emission rate of 0.32 g/hp-hr) and 50% for Tier 2 rebuilds from Tier 2 base emissions (0.20 to 0.10 g/hp-hr PM emission rate reduction).

Table 4-4 provides expected fleet composition with introduction of the Tier 3 and Tier 4 engines replacing the South Coast fleet. ENVIRON assumes that the introduction of Tier 3 and 4 engines could replace the fleet of Tier 0 / 1 / 2 engines in equal proportion and so the fleet fraction of remaining Tier 0, 1, and 2 engines were proportionally reduced.

Table 4-4. Fleet composition estimate in the South Coast in future years.

Engine Model	2010	2015	2020
Tier 0	10%	1.3%	0.0%
Tier 0 rebuild	0%	7.5%	7.3%
Tier 1	15%	2.0%	0.0%
Tier 1 rebuild	0%	11.2%	11.0%
Tier 2	75%	49.5%	6.8%
Tier 2 rebuild	0%	16.5%	47.9%
Tier 3	0%	9.0%	9.0%
Tier 4	0%	3.0%	18.0%
Overall	100%	100%	100%

Idle emission reductions are difficult to predict. The 2005 emissions were estimated using an idle period of 1 hour during sand and fuel service (SFS), the primary service at Commerce-Mechanical, and 30 minutes once removed to the ready tracks. ENVIRON assumed that the idle shut-off devices would reduce engines idle time to 30 minutes during refueling and 15 minutes when removed to the ready tracks per arrival of new Tier 2 engines with factory installed idle limiting timers.

b) Switching Locomotives

Based on conversation with BNSF, the switching engines will continue to be Tier 0 compliant and remanufactured according to the schedule that EPA has finalized. The emissions for switching engines will be affected by the MOU idle reduction measure in addition to the remanufacturing emissions reductions. It will take a study to determine the idle reduction due to idle shut off devices installed on these engines. Because some emission reduction will be realized with these devices, ENVIRON assumed 30% reduction of the idle mode.

c) Maintenance

When the maintenance schedules were reviewed for the past 4 years, it was discovered that the number of locomotives undergoing sand and fuel service (SFS) was underestimated in the MOU analysis. The 2005 estimates were then updated to include the revised figures prior to conducting the emissions forecast. The sand and fuel service is labeled as "Basic Service" in this analysis.

2. HHD Diesel-Fueled Drayage Trucks

There are no regular visits of drayage trucks at this facility.

3. Cargo Handling Equipment (CHE)

There are no CHE types serving this yard.

4. Heavy Equipment

There are very few regular visits of heavy vehicles arriving at this facility. What operations do occur are covered under miscellaneous that include track maintenance and portable engines dedicated to the site.

5. Transport Refrigeration Units (TRUs) and Refrigerated Railcars (Reefer)

There are no TRUs operating within this facility.

6. Other Miscellaneous Diesel-Fueled Equipment

Other offroad equipment primarily consists of track maintenance equipment with portable engines occasionally used for general industrial purposes. Track maintenance equipment is comprised of any number of various equipment types from small pumps and generators to larger, specially designed equipment for rail line maintenance. However, equipment based at each site is used over the entire rail network, so a low fraction of this equipment activity and emissions occur on site.

To estimate emission reductions from this equipment, an OFFROAD model run using construction and industrial equipment was made to determine the relative emission reduction. The emission reduction equipment with rated power of 50 – 500 hp (the breadth of the equipment found at rail yards) are typically similar even though the standards and phase-in schedules for new emission standards vary by engine power. ENVIRON estimated the average emission reduction for 2010 at 14%, 2015 at 36%, and 2020 at 59%.

V. Projected Growth Rates

Historic activity data from calendar years 2002 through 2007 were reviewed to determine the expected activity growth rate for the Commerce – Mechanical Yard refueling totals. The 2007 activity was 4% below the 2005 base year activity. The mainline traffic past Commerce was used to forecast the mainline activity emissions. Table 5-1 summarized the historic activity data for the Commerce – Mechanical Yard.

Table 5-1. Historic Activity Data for Diesel-Fueled Equipment Commerce-Mechanical Rail Yard.

Activity	Historic Actual Data										Growth Rate (%)
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008[1]	
Sand Fuel Service (SFS) (locomotives)							17,804[2]	18,387	18,727	17,521	-0.5%
Fuel Dispensed (gallons)				25,706,943	26,927,387	29,767,019	31,573,289	31,475,921	30,232,753	N/A	0.5%
Engine Inspection (locomotives)							1,012	904	1,159	1,071	1.9%
Mainline traffic (Million Gross Tons)	73	75	71	72	84	86	91	102	100	N/A	4.0%

1 – Data through August 27 was prorated to the full year.
2 – Original MOU analysis was reported as 14,577

Shown in Table 5-1 are the historic data activity estimates at the Commerce-Mechanical. There are three main activities at this facility, sand and fuel service, engine inspections, and main line traffic. The refueling service could either use fuel gallons dispensed or, more appropriate to engine activity, the number of locomotives serviced. In either case the growth has been nearly zero over the past three years. The number of engine inspections has climbed about 1.9% per year from 2005 through 2008. The mainline traffic moving past Commerce however has been increasing at a rate of about 4% per year based on data from 1999 through 2007.

VI. Mitigation Measures

1. Current Mitigation Measures

BNSF has implemented all measures in the MOU with the state and continues to comply with all rules.

2. Proposed Future Mitigation Measures

BNSF will work with local and state authorities to investigate additional mitigation measures.

VII. Evaluation of Additional Mitigation Measures

The evaluation of the current and proposed mitigation measures will be conducted once the mitigation measures have been specifically defined.

VIII. Mechanisms for Tracking Progress

BNSF will work with state officials to determine a method for tracking the emissions reductions achieved through the implementation of the Mitigation Measures.

IX. Conclusions

The emissions at the Commerce-Mechanical yard will be reduced by about 63% by 2020 without considering any additional mitigation measures.